Annals of Clinical and Analytical Medicine
Original Research

Is robotic surgery safe in patients with rectum cancer and multiple comor-bidities?

Robotic surgery and co-morbidity

Mustafa Yener Uzunoglu[1], Fatih Altintoprak[2], Enis Dikicier[3], Omer Yalkin[4], Yesim Akdeniz[3], Kayhan Ozdemir[2], Burak Kamburoglu[2], Fehmi Celebi[2]
[1] Department of General Surgery Bursa City Hospital, Bursa
[2] Department of General Surgery, Faculty of Medicine, Sakarya University, Sakarya
[3] Department of General Surgery, Sakarya University Research and Educational Hospital, Sakarya
[4] Department of Surgical Oncology, Bursa City Hospital, Bursa, Turkey

Abstract
Aim: In this article, by combining the facts that the incidence of colorectal cancer accompanied by multiple comorbidities has increased and that robotic surgery is being used increasingly, it was investigated whether robotic surgery applications were reliable in this group of high-risk patients.
Material and Methods: The records of patients with the diagnosis of rectum cancer who un-derwent surgery between January 2011 and January 2019 were reviewed retrospectively. Pa-tients who were older than 65 years, with 2 or more comorbid diseases, with no neoadjuvant treatment protocol in the preoperative period, and with the tumor localization in the middle or distal rectum were evaluated in the study. In terms of the surgical procedure applied, the patients were divided into 3 groups: laparoscopic (L), robotic (R), and open (O) rectal resection.
Results: Of the 86 patients included in the study, 41 patients (47.6%) underwent open surgery (group O), 29 patients (33.7%) laparoscopic surgery (group L), and 16 patients (18.6%) robotic surgery (group R). The two most common comorbidities were diabetes mellitus (DM) (65.5%) and hypertension (56.1%). In this study, there were no differences between our groups in terms of postoperative intensive care requirements and early mortality and morbidity rates.
Discussion: Robotic surgery does not adversely affect early postoperative outcomes and can be safely applied to the patient group at high risk due to the presence of comorbid diseases.

Keywords
Rectal Cancer, Robotic Surgery, Minimally Invasive Surgery, Multiple Comorbidities

DOI: 10.4328/ACAM.21226 Received: 2022-05-12 Accepted: 2022-06-21 Published Online: 2022-06-21 Printed: 2022-10-01 Ann Clin Anal Med 2022;13(10):1112-1116
Corresponding Author: Mustafa Yener Uzunoglu, Bursa Şehir Hastanesi, Doğanköy Mahallesi, 16110, Nilüfer, Bursa, Turkey.
E-mail: mdyeneruzunoglu@gmail.com P: +90 224 975 00 00 F: +90 224 268 00 62
Corresponding Author ORCID ID: https://orcid.org/0000-0001-8133-2311

Introduction

Minimally invasive approaches, which were included in general surgery in the 1980s, have rapidly become widespread and are the first-choice surgical method in many abdominal surgical procedures today [1]. Especially in the field of colorectal surgery, laparoscopic experiences have increased more rapidly, and prospective studies have shown that the technique is favorable and reliable, with oncologic outcomes similar to open surgery [2].

Because of the presence of laparoscopic surgical experience, the surgeon's adaptation to robotic surgery has been shorter, and nowadays it is known that the oncologic outcome of robotic surgery is not different from open or laparoscopic surgery [3, 4]. Therefore, is no debate left about the application of laparoscopic or robotic surgery for patients with colorectal cancer, and the field of debate has shifted towards expanding the applicability of these methods.

Due to the development of patient care conditions, patients who were previously in the risk group for open surgery have begun to be assessed as candidates for minimally invasive surgery. While different parameters are included in the definition of patients in the risk group, currently, the presence of chronic co-morbid diseases, especially multiple chronic comorbid diseases, has also been included in the classification criteria of high-risk patients [5].

In this article, by combining the facts that the incidence of colorectal cancer accompanied by multiple comorbidities has increased and that robotic surgery is being used increasingly, it was aimed to investigate whether robotic surgery applications were reliable in these patients evaluated as being in a high-risk group.

Material and Methods

The records of patients with the rectal cancer diagnosis who underwent surgery between Janu-ary 2011 and January 2019 were reviewed retrospectively. Permission for this study was ob-tained from Sakarya University Faculty of Medicine Clinical Research Ethics Committee. Pa-tients who were older than 65 years, with 2 or more comorbid diseases, with no neoadjuvant treatment protocol in the preoperative period, and with the tumor localization in the middle or distal rectum were evaluated within the scope of the study. Patients who undergone surgery for local recurrence, who had a synchronous tumor or other localization of a second primary tumor, who had only one co-morbid disease, had neoadjuvant therapy, who had undergone abdom-inoperineal resection, who had irregular clinical follow-up or had no access, even by telephone, were excluded from the study.

According to the surgical procedure applied, the patients were categorized into three groups: laparoscopic resection (L), robotic resection (R), and open resection (O).

Surgical technique

The dissection was performed from the lateral to the medial in the open surgery group, whereas it was performed from the medial to the lateral in the laparoscopic and robotic surgery groups. The Inferior Mesenteric Vein (IMV) was ligated at the level of the Ligament of Treitz. In the robotic group, stages of IMV ligation and splenic flexure release were completed laparoscopically, and then the robotic system was docked. Distal resection in the laparoscopic and robotic groups was performed using Endo GIA (Endo GIA™ 60 mm Articulating Stapler, Covidien, USA). Proximal resection was performed by electrocautery, and the anastomosis was per-formed intracorporeally following the insertion of the anvil of the circular stapler.

Statistical analysis

The Kolmogorov–Smirnov test was used to determine if the continuous and intermittent numer-ical variables showed normal distribution, and the homogeneity of variances were investigated with the Levene test. Descriptive statistics of continuous and intermittent numerical variables were expressed as mean ± standard deviation or median (minimum–maximum), while categori-cal variables were expressed as number of cases and percentage (%). The significance of the difference between the groups in terms of mean age was assessed using one-way ANOVA, whereas the significance of differences in terms of T-phase, number of lymph nodes, and dura-tion of operation were evaluated using the Kruskal–Wallis test. Analyses of categorical data in cross-tabulations of RxC (if at least one of the categorical variables in the row or column were duplicate outcomes) were performed using Pearson's Chi-Square or Likelihood-Ratio test. Analysis of the data was performed using IBM SPSS Statistics 17.0 (IBM Corporation, Ar-monk, NY, USA). For $p < 0.05$, the results were considered statistically significant.

Results

Demographic data and preoperative parameters

A total of 252 patients with a rectal cancer diagnosis underwent surgery between the dates men-tioned. In this study, the data obtained from 86 (34.1%) of the 252 patients were evaluated in detail. Of these patients, 34 were female (39.5%) and 52 were male (60.5%). The mean age was 70.3±5.4 years (range: 65-89 years). Forty-one patients (47.6%) underwent open surgery (group A), 29 patients (33.7%) laparoscopic surgery (group L), and 16 patients (18.6%) robotic surgery (group R). BMI values predominantly fell into the range of 25-30 (43%) (mean BMI: 26.30 ± 2.17 kg/m2). When comorbid diseases were evaluated, it was determined that Diabetes Mellitus (65.5%) and Hypertension (56.1%) were the most two common comorbidities. The ASA score was determined as III in 63 patients (73.2%). Tumor localization was determined as middle rectum in 55 patients (64%) and distal rectum in 31 patients (36%) When preoperative staging was assessed, it was determined that 1 patient had intramucosal carcinoma (Stage-0) (1.16%), 37 patients had Stage-1 disease (43.02%) and 48 patients had Stage-2 disease (55.8%). Demographic data and preoperative parameters of all patients are shown in Table 1.

Preoperative and early postoperative parameters

The operation times were 140 (90-270) min in the open group, 200 (170-240) min in the lapa-roscopic group, and 218 (170-330) min in the robotic group. In the laparoscopic surgery group, the operation was continued with open surgery due to presacral bleeding in one patient (3.4%) and obesity in one patient (3.4%). Due to obesity seen in one patient (6.3%) in the robotic group, the operation had to be shifted to open surgery. Protective ileostomy was applied to 51 patients (59.3%), while the remaining 35 patients (40.7%) did not undergo this

procedure.

Eleven patients (12.7%) required reoperation in the early postoperative period (bleeding in 6 patients, 6.9%; anastomotic leakage in 5 patients, 5.8%). Four (9.7%) open surgery patients and 2 (6.8%) laparoscopic surgery patients were re-operated on due to hemorrhage. In the re-operations, none of the patients were found to have major vascular hemorrhagic foci, whereas hemostasis was performed in 3 patients (50%) who had minor vascular hemorrhagic foci in the colon mesothelium. No hemorrhagic foci were found in the other 3 patients (50%). In the robot-ic group, there was no requirement for reoperation due to hemorrhage. Four patients (9.7%) in the open surgery group and one patient (3.4%) in the laparoscopic group required reoperation due to anastomotic leakage. During reoperations, anastomosis was halted, and the Hartmann procedure was applied subsequently. In both laparoscopic and robotic groups, endoscopic stent-ing was performed in one patient who was found to have anastomosis.

Table 1. Demographic and clinical characteristics of the cases by group

	Open (n=41)	Laparoscopic (n=29)	Robotic (n=16)	p-value
Age (years)	72.4±6.5	70.5±5.4	68.7±5.6	0.091†
Gender				
Male	25 (61.0%)	19 (65.5%)	8 (50.0%)	0.592‡
Female	16 (39.0%)	10 (34.5%)	8 (50.0%)	
Comorbid disease				
DM	35 (85.4%)	19 (65.5%)	11 (68.8%)	0.127‡
HT	23 (56.1%)	19 (65.5%)	11 (68.8%)	0.589‡
CAD	15 (36.6%)[a]	4 (13.8%)	0 (0.0%)[a]	0.005‡
COPD	0 (0.0%)[a]	3 (10.3%)	3 (18.8%)[a]	0.012¶
Anti-COAG	3 (7.3%)[b]	9 (31.0%)[b]	2 (12.5%)	0.031¶
CVO	4 (9.8%)	4 (13.8%)	0 (0.0%)	0.154¶
CHF	1 (2.4%)	1 (3.4%)	2 (12.5%)	0.333¶
CRF	0 (0.0%)	2 (6.9%)	2 (12.5%)	0.057¶
Other	4 (9.8%)	3 (10.3%)	3 (18.8%)	0.645¶
BMI				
Normal	8 (19.5%)	4 (13.8%)	4 (25.0%)	0.854¶
Overweight	23 (56.1%)	19 (65.5%)	8 (50.0%)	
Obese	10 (24.4%)	6 (20.7%)	4 (25.0%)	
ASA				
II	13 (32.5%)	7 (24.1%)	3 (18.8%)	0.526‡
III	27 (67.5%)	22 (75.9%)	13 (81.2%)	

† One-way ANOVA, Pearson's Chi-Square test, ¶ Likelihood ratio test,
a: difference between open and robotic surgery group was statistically significant (p<0.05),
b: difference between the open surgery group and the closed surgery group was statistically significant (p=0.021).

Table 2. Other clinical features and results of the cases by group

	Open (n=41)	Laparoscopic (n=29)	Robotic (n=16)	p-value
T stage				0.009†
Intramucosal		1 (3.5%)		
1	8 (19.5%)	2 (6.9%)	4 (25.0%)	
2	17 (41.5%)[a]	5 (17.2%)	6 (37.5%)[b]	
3	16 (39.0%)	21 (72.4%)[a,b]	6 (37.5%)	
Lymph node count	16 (5-34)	14 (7-30)	15 (8-26)	0.310†
Conversion to open	-	2 (6.9%)	1 (6.3%)	>0.999‡
Operation time	140 (90-270)[a,c]	200 (170-240)[a]	218 (170-330)[c]	<0.001†
Complication				
HEMORRHAGE	4 (9.8%)	2 (6.9%)	0 (0.0%)	0.253¶
WSI	7 (17.1%)	2 (6.9%)	1 (6.2%)	0.084$
DVT	1 (2.4%)	0 (0.0%)	0 (0.0%)	-
ANASTOMOTIC LEAKAGE	4 (9.8%)	1 (3.4%)	0 (0.0%)	0.885¶
REOPERATION	8 (19.5%)[c]	3 (10.3%)	0 (0.0%)[c]	0.046$
INCISIONAL HERNIA	7 (17.1%)	3 (10.3%)	0 (0.0%)	0.080¶
POST-OP ICU	5 (12.2%)	5 (17.2%)	5 (31.3%)	0.234$
Mortality	2 (6.9%)	1 (3.4%)	0 (0.0%)	0.253¶

WSI (wound site infection), DVT (deep vein thrombosis), ICU (Intensive care unit)
† Kruskal Wallis test, ‡ Fisher's exact result probability test, ¶ Likelihood ratio test,
$ Pearson's Chi-square test, a: difference between the open surgery group and the closed surgery group was statistically significant (p<0.01) b: difference between closed and robotic surgery groups was statistically significant (p=0.014). c: difference between open surgery group and robotic surgery group was statistically significant (p<0.05).

A total of 15 patients (17.4%) were enrolled in postoperative follow-up intensive care (5 of the patients in the open surgery group, 12.1%; 5 of the patients in laparoscopic group, 17.2%; 5 of the patients in robotic group, 31.2%). Thirteen of the 15 patients (86.6%) were hospitalized after a 24-hour intensive care, while 2 patients (13.4%) were in intensive care for more than 24 hours.

One patient in the open surgery group (2.4%) who had DVT in the lower extremity underwent medical therapy. DVT was not detected in the minimally invasive surgery groups.

A total of 3 patients died within the first 30 days after surgery (among patients in the open sur-gery group, 1 patient (2.4%) died in the first 24 hours due to myocardial infarction, 1 patient (2.4%) died on postoperative day 4 due to massive pulmonary embolism, and 1 patient (2.4%) died due to cardiovascular causes 22 days after hospital discharge).

Superficial wound infections occurred in 15 patients (17.4%) (7 of the patients in open surgery group, 17%; 2 of the patients in laparoscopic group, 6.9%; 1 of the patients in robotic group, 6.2%). Only patients with anastomotic leakage developed deep surgical site infection.

When groups were evaluated for duration of hospital stay, the time was found to be 9.1 days (5-28) in the open surgery group and 6.2 (5-9) and 6.4 (5-11) in the laparoscopic and robotic group, respectively.

The number of lymph nodes dissected was 16 (5-34) in the open surgery group, 14 (7-30) in the laparoscopic group and 15 (8-26) in the robotic group. Preoperative and early postoperative parameters of all patients are shown in Table 2.

Discussion

With the realization of laparoscopic rectal cancer surgery by Dr. Jacobs, the first laparoscopic rectal cancer surgery operations were performed in 1991, and in the following years, this method was shown to be feasible and effective in various prospective studies [6].

Experiences have greatly increased since the early use of robotic methods in rectal cancer sur-gery, and sufficient experience and knowledge have been gained in this area. However, there are still doubts about the use of robotic surgery in patients with advanced age and multiple co-morbidities. The robotic surgery operation time for various procedures has been shown to be longer than open and laparoscopic techniques [7]. However, with the increase in experience and the development

of robotic systems, the operation times have come to the point of equalizing with laparoscopic surgery. In the study by Wang et al, it was also indicated that the application of robotic rectal surgery in centers with laparoscopic surgery experience does not differ in terms of operation time [8].

In terms of oncologic results, robotic surgery by colorectal cancer surgeons is now known to be equivalent to open and laparoscopic surgery [4]. In the meta-analysis by Li et al. including 3601 cases and 17 studies, robotic rectal cancer surgery was found to be similar to laparoscopic sur-gery in terms of oncologic and functional outcomes [9]. In the same study, it was found that laparoscopic and robotic surgeries have similar results in terms of circumferential surgical mar-gin negativity, local recurrence, 3-year survival rates, and postoperative complications rates. Staderini et al. reported in their review, examining the results of 3013 patients with moderate and distal rectal cancer, determined that laparoscopic-robotic surgery had similar oncologic out-comes compared to open surgery and lower postoperative complication rates [10]. In our study, oncologic results were found to be similar in all three groups in accordance with the literature.

There are a limited number of studies demonstrating that the use of minimally invasive surgery is safe and feasible in a population of elderly patients with rectal cancer accompanied by system-ic co-morbidities [11]. In this group of patients, there are far fewer studies on the results of ro-botic surgeries. It was reported that robotic surgery is safe in the study by Oldani et al. involv-ing 50 patients over 70 years of age undergoing robotic surgery [12]. The fact that our patients have multiple comorbidities is another aspect compared to the work of Oldani et al. In a study comparing robotic surgery and laparoscopic surgery in patients with rectal cancer in the high-risk group, Fernandez et al. reported that the results of the robotic surgeon were as safe as lapa-roscopy in terms of postoperative complications [13]. In our study, similar oncologic and post-operative results were obtained in accordance with the study by Fernandez et al. Our study dif-fers from the study by Fernandez et al. in that patients who underwent open surgery are also included, and thus we have the feasibility to compare the outcome of the open method with the results of minimally invasive methods involving the combination of laparoscopic-robotic sur-gery [13].

Although laparoscopic and robotic methods indicate that the duration of surgery is equal to the open method in experienced centers, it is a fact that the total duration of anesthesia is longer due to the technical details and preparations in these methods [14] (docking, insufflation, trocar placement, patient position). This difference in time is greater in centers that have not yet com-pleted the learning curve for minimally invasive surgery [15]. The most important factor for the shortening of this training time is experience [16]. Our results were similar to those of experi-enced centers, and the duration of total anesthesia was longer in the minimally invasive surgery group than in the open group. When the laparoscopic and robotic groups were evaluated within themselves, the length of time in the robotic group was not significantly different.

Although the patients in our study had multiple co-morbidities, and the duration of surgery in the robotic surgery group was not statistically significant, there were no differences in postoper-ative intensive care requirement and early mortality rates between the groups. We are of the opinion that this was the most important outcome of our work.

It has been indicated in the literature that there are several determinants for a return to open sur-gery in minimally invasive surgery, and it has been emphasized that factors such as experience, technical obstacles, obesity, and large tumor size are the most important causes [17, 18]. The retrospective nature of the study and the insufficient number of patients involved are the limiting aspects of this study. Minimally invasive methods have proven to be sufficient in the surgical treatment of colorectal cancers.

Conclusion

We are of the opinion that the long operation time in robotic surgery does not adversely affect the outcome in patients who are considered to be in the high-risk group due to the presence of comorbid diseases and that robotic surgery can be applied safely in this patient group.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:
Mustafa Yener Uzunoglu, Fatih Altintoprak, Enis Dikicier, Omer Yalkin, Yesim Akdeniz, Kayhan Ozdemir, Burak Kamburoglu, Fehmi Celebi. *Is robotic surgery safe in patients with rectum cancer and multiple comor-bidities?. Ann Clin Anal Med 2022;13(10):1112-1116*